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ABSTRACT

The way that planning tools can be used to evaluate the economic consequences of implementing new academic programs at Grambling State University (GSU) is considered. The focus is projecting cost behavior for planning and decision making. The following planning tools are examined: cost-volume-revenue analysis, cost behavior analysis and least squares, and differential analysis (incremental revenue and incremental students). Educational and General (E&G) expenditures for five previous years and cost projections for new programs were used to predict fixed cost proportions of E&G expenditures. Two scenarios were prepared to assure accuracy and validity in cost predictions. It was found that the fixed cost proportions of GSU's E&G expenditures were not the same as those of other institutions having similar operating conditions. In addition, financial instability could occur if GSU did not fund a higher level of fixed costs resulting from the proposed new programs. The university's operating budget would have to increase by a minimum of 24 percent per scenario one, and 19 percent per scenario two. Among many graphs and tables are those showing: the relationship of cost and revenue to different levels of volume (the number of students); cost formulas; and the calculation of fixed and variable expenditures. (SW)

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A CLOSER LOOK AT COST BEHAVIOR PATTERNS AND THE IMPLEMENTATION OF NEW PROGRAMS

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This paper was presented at the Twenty-Fifth Annual Forum of the Association for Institutional Research held at the Portland Hilton in Portland, Oregon, April 28-May 1, 1985. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum papers.

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A CLOSER LOOK AT COST BEHAVIOR PATTERNS AND THE IMPLEMENTATION OF NEW PROGRAMS

ABSTRACT

This paper focuses on projecting cost behavior for planning and decision-making. Administrators need to know what costs to anticipate under a variety of assumptions so that rational choices among alternatives can be made.

An express purpose of the paper is to provide administrators with a basic understanding of how the following planning tools can be utilized to evaluate the economic consequences of implementing new programs:

(1) Cost-Volume-Revenue Analysis

(2) Cost Behavior Analysis and Least Squares

(3) Differential Analysis (Incremental Revenue and Incremental Students)

In carrying out the objective of this paper, the author uses a case study approach.

INTRODUCTION AND PERSPECTIVES

Grambling State University (GSU) is a nationally and internationally known institution located in the rural North Central region of Louisiana. The university is a public institution which has traditionally served a predominant population of black students who are economically, educationally and socially disadvantaged. The institution has a current enrollment of 4767 students, of whom sixty-five percent are housed in campus dormitories. Approximately ninety-five percent of GSU's students receive financial aid. GSU has 240 full-time faculty members.

The recent settlement of the Higher Education Desegregation Litigation in the State of Louisiana gave GSU the ability to enhance its image and prestige by offering fourteen new graduate and eight new undergraduate programs. Even though the Consent Decree stipulated that funds would be provided for the implementation of the new programs, several important questions had to be addressed:

1. Would the level of funding recommended by the Board of Regents be adequate to ensure the survival of the programs and to ensure their high quality?

2. Could GSU absorb the incremental fixed and variable costs emanating from the new programs?

3. Would the university's break-even point occur at a significantly higher level of enrollment?

4. Would the fixed cost emanating from the new programs become an increasing proportion of current operating income and cause financial instability and/or financial inflexibility?

5. Would the new level of funding continue after the end of the Consent Decree in 1987-88?

In facing the crucial issues surrounding the use of scarce resources to fund Consent Decree Programs, GSU's executive management requested the Office of Planning and Analysis to study the impact of program implementation upon

the Operating Budget. The implementation of new programs would occur during an era of economic uncertainty and instability in the State of Louisiana.

In the present economic environment, and for the foreseeable future, GSU will remain strong if it can either find new sources of support or systematically analyze and adopt the university's programs so as to use resources more effectively. Central to these concerns, was the need to examine the potential economic consequences of implementing various Consent Decree Programs. If GSU's administrators were to respond appropriately to the individual and collective needs of the institution, they had to have improved tools for planning and managing resources.

An understanding of cost behavior is the key to many decisions in an organization, in that by understanding how costs behave, a manager is better able to predict what costs will be under various operating conditions. Experience has shown that attempts at decision making without a thorough understanding of the costs involved - and how these costs may change with the activity level can lead to disaster. For example, a decision to implement several Consent Decree Programs, might result in the incurrence of far greater additional costs than could be generated in additional revenues. To avoid such problems, GSU's administrators had to be able to predict accurately what costs will be at various activity levels. In this paper one shall find that the key to effective prediction lies in an understanding of cost behavior patterns.

PURPOSE

The purpose of this paper is to provide administrators with a basic understanding of how the following planning tools can be utilized to evaluate the economic consequences of implementing new academic programs:

1. Cost-Volume-Revenue Analysis
2. Cost Behavior Analysis and Least Squares
3. Differential Analysis (Incremental Revenue and Incremental Students)

The planning tools identified above are not new tools or concepts. Many industrial firms have used these tools in projecting their operations for many years. In contrast, the application of these tools in colleges and universities is not widespread.

This study focuses on projecting cost behavior for planning and decision-making. Administrators need to know what costs to anticipate under a variety of assumptions so that rational choices among alternatives can be made.

DATA COLLECTION AND ANALYSIS

Data on the Educational and General Expenditures (E & G) of GSU were collected from the institution's internal financial statements and other official documents. The E & G expenditures for the last five years were carefully examined. Additionally, data about new programs were collected from budget request documents.

Data taken from the various documents were summarized and inputted into GRIDS (Grambling Institutional Data System). After data input, a linear regression program was employed to develop cost formulas for the E & G expenditures. These cost formulas were then utilized in predicting the fixed cost proportions of E & G expenditures.

METHODOLOGY/APPROACH

The paper uses a case study approach in explicating how GSU evaluated economic consequences of adding new programs.

In carrying out the objectives of the study, the author prepared two scenarios to assure accuracy and validity in cost predictions:

Scenario I - This scenario was based on the assumption that the fixed cost proportions of GSU's Educational and General Expenditures are the same as other institutions having similar operating conditions. In testing this

tentative assumption, the analyst applied fixed cost proportions, which were developed by the Ohio Board of Regents, to GSU's E & G expenditures. The most important aspect of this scenario was the section dealing with cost-volume-revenue analysis.

Scenario II - This scenario was prepared to affirm or disaffirm the assumption of Scenario I, by developing GSU's fixed cost proportions via cost behavior analysis. It is important to point out that these fixed cost proportions were derived from the university's accounting data. The most important planning tool used in the cost behavior analysis was the least squares method (linear regression).

COST-VOLUME-REVENUE ANALYSIS

Cost-volume-revenue analysis can be applied to examine the possible consequences of decisions about the use of resources. More specifically, cost-volume-revenue analysis permits planners to examine how changes in volume will affect cost and revenue. This analysis relies on understanding the fixed, variable, and mixed nature of cost behavior. (Robinson, Ray & Turk, 1977, p. 14).

The relationship of volume to cost and revenue is portrayed on a cost-volume-revenue chart, which shows the fixed, variable, and mixed cost (semi-variable) projections. Also, the chart shows the relationship of revenue and cost to volume at a single point in time. When preparing the chart, the analyst uses cost and revenue projections for a relevant range of volume. Projections of cost and revenue above or below the relevant range may behave differently (Robinson et al., 1977).

An example of a cost-volume revenue chart appears as Figure I, which shows the effect of Consent Decree Programs on GSU's enrollment, cost, and revenues. The chart illustrates the point at which the number of students (volume) must increase to in order to cover the incremental cost of Consent

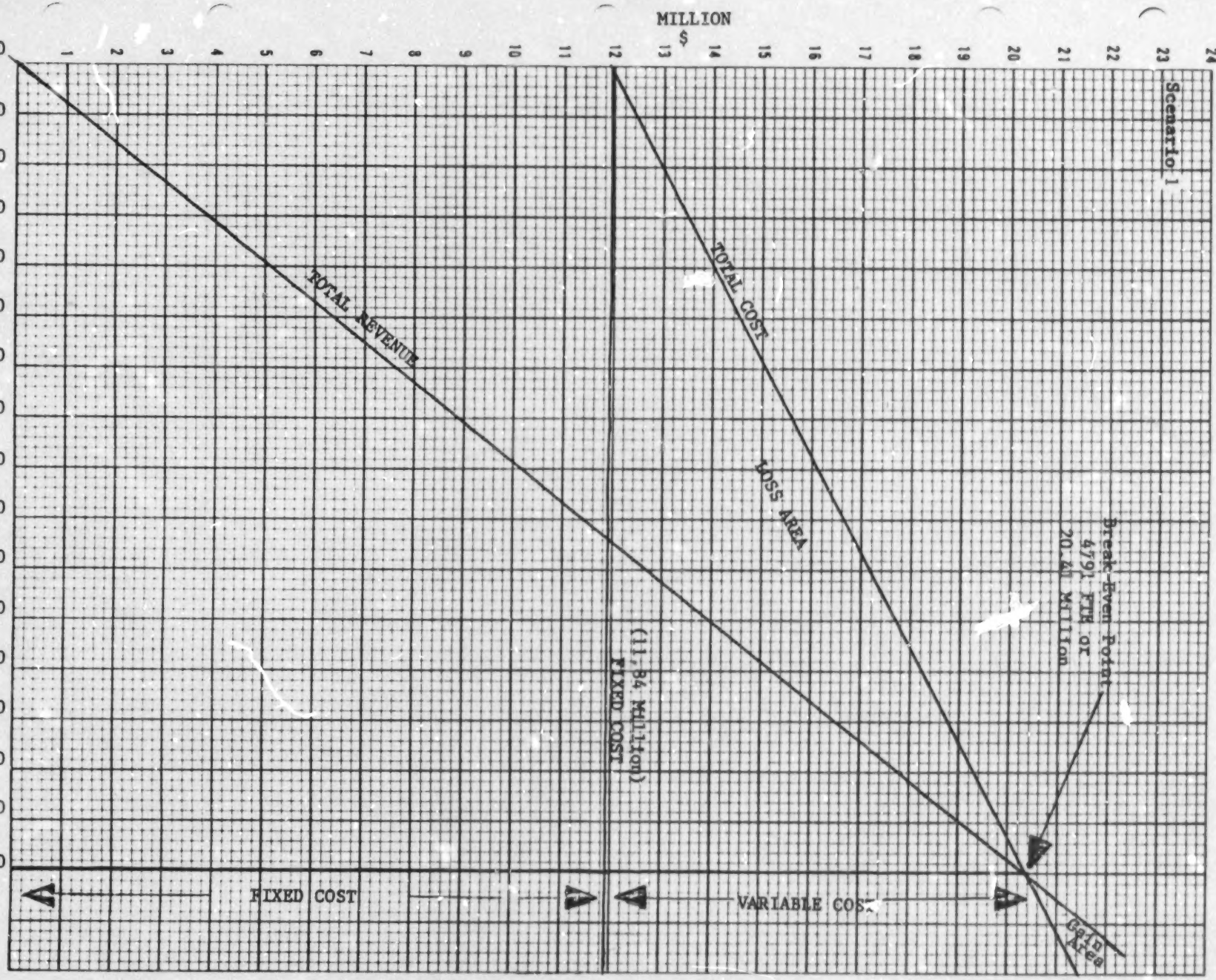


Figure 1 COST-VOLUME-REVENUE GRAPH

Decree Programs. This particular point is commonly known as the "break-even point" (BEP) and implies that the university neither generates excess revenue, nor suffers a loss at this level of operations. Also, the chart illustrates points at which the number of students will result in either an overall loss to the institution, because the revenue from the students is less that the total cost of instruction (Unrestricted Educational and General Expenditures), or a gain, because the revenue received is more than the total cost of instruction. Other cost-volume-revenue charts depicting different assumptions were prepared and presented to executive management.

On the chart, revenue is presented as directly variable with volume. The analyst has assumed that revenue per student is constant over the relevant range of student demand for instructional services. Because of this assumption, the total revenue line is linear in relation to volume.

Cost is depicted as fixed and variable. Mixed cost has been separated into its fixed and variable components. Fixed cost remains constant in total for all levels of volume within the relevant range. Because the chart depicts the short-run relationship of cost to volume, most of the total cost is fixed. Variable cost per student is assumed to be the same over the relevant range of student demand being projected. Therefore, the total variable cost and the total cost line are linear in relation to volume (Garrison, 1982, p. 152).

By presenting the relationship of cost and revenue to different levels of volume, the analyst can also identify the point at which equilibrium between gain and loss is achieved. As evidenced in Figure 1, enrollments below 4791 students indicate that the university is incurring a loss, whereas enrollments above that point indicate a gain. This is because revenue per student is assumed to be constant while the cost per student will decrease as volume is increased (because fixed cost per student decreases as volume increases).

Because of the high percentage of fixed cost to total costs at all levels of volume considered, there is an extreme leveraging effect as volume varies above and below the breakeven point. Tables 1 and 2 show the calculation of fixed and variable expenditures by applying the fixed cost proportions developed for the Ohio Board of Regents (Baughman & Young, 1982). The determination of fixed costs was an important step in ascertaining GSU's break-even point.

Computation of the Break-Even Point

Data for break-even analysis cannot be taken directly from the conventional or full cost income statement. The form of the statement and the manner in which data are presented do not permit a convenient and practical analysis for planning, policy making, and the determination of excess revenue. The conventional income statement must, therefore, be broken down to show the fixed and variable portions of each cost. Of the three classes of expenses: fixed, semivariable, and variable, the semivariable expenses must be separated into their fixed and variable components. The fixed portion is stated as a total figure and the variable portion is expressed as a rate or a percentage. After this had been completed, the costs and expenses in a conventional income statement were restated as shown in Table 3.

The above figures show that out of every dollar of revenue $.42 or 42% of the total, is required to pay variable costs. The balance, 58%, is available to cover all other costs and achieve excess revenue. Each dollar of revenue contributes $.58 toward this goal. To find revenue required to recover the fixed expenditures of $9,571,309, only the total fixed expenditures are divided by 58%:

$$\frac{\$9,571,309}{.5800799} = (\$16,499,986 = \text{Break-Even Point in Dollars})$$

TABLE 1 - SCENARIO 1
CALCULATION OF FIXED AND VARIABLE EXPENDITURES

Expenditure Category	1982 - 83 Actual Expenditures	X	Fixed Cost Proportion	=	Fixed Expenditures
INSTRUCTION:					
Graduate	$ 168,266	X	.736	=	$ 123,844
Undergraduate	Ⓐ 6,063,805	X	.597	=	3,620,092
Total	$6,232,071				3,743,936
Research	16,794	X	.500	=	8,397
Public Service	285,273	X	.500	=	142,637
Academic Support	1,546,112	X	.575	=	889,014
Student Services	999,169	X	.500	=	499,585
Institutional Support	3,230,106	X	.500	=	1,615,053
Operation & Maintenance of Plant	2,138,726	X	.770	=	1,646,819
Scholarships and Fellowships	1,144,277	X	.500	=	572,139
Athletics	907,458	X	.500	=	453,729
Total	$16,499,986				$9,571,309
Total Expenditures	16,499,986				
Less: Fixed Expenditures	9,571,309				
Variable Expenditures	$ 6,928,677				

Ⓐ

	SCH's	%		Cost Apportionment	
Undergraduate	56,161	97.3	X	$ 6,232,071	=$6,063,305
Graduate	1,545	2.7	X	6,232,071	= 168,266
Total	57,706	100.0			6,232,071

TABLE 2 - SCENARIO 1

PROJECTED FIXED COST OF CONSENT DECREE PROGRAMS

Program	1984-85 Budget Request	Fixed Cost Proportic	Projected Fixed Cost (Column 1 X Column 2)
1. Nursing	$ 1,106,669	.736	$ 814,508
2. Allied Health	114,265	.597	68,216
3. MBA	494,275	.736	363,786
4. Public Administration (Masters)	55,600	"	40,922
5. Master In Social Work	401,476	"	295,486
6. MS Criminal Justice	193,344	"	142,301
7. MS - Teaching/NS	81,625	"	60,076
8. MS - Teaching/SS	118,544	"	87,248
9. MA - Liberal Arts	190,413	"	140,144
10. Developmental Ed - M.S. Ed.	293,494	"	216,012
TOTAL	$ 3,049,705		$ 2,228 699

TABLE 3 - SCENARIO 1

GRAMBLING STATE UNIVERSITY
RESTATEMENT OF CONVENTIONAL INCOME STATEMENT
FOR YEAR ENDED JUNE 30, 1983

Expense Category	Total	Variable	Fixed
Instruction	$ 6,232,071	$ 2,488,135	$ 3,743,936
Research	16,794	8,397	8,397
Public Service	285,273	142,636	142,637
Academic Support	1,546,112	657,098	889,014
Student Services	999,169	499,584	499,585
Institutional Support	3,230,106	1,615,053	1,615,053
Operation & Maintenance of Plant	2,138,726	491,907	1,646,819
Scholarships & Fellowships	1,144,277	572,138	572,139
Athletics	907,458	453,729	453,729
Total Expenditures	$16,499,986	$6,928,677	$ 9,571,309
Percentage of Revenue		42%	

The 58% is referred to as the marginal income ratio, the contribution margin income ratio, or the P/V (profit-volume) ratio.

The resulting $16,499,986, known as the break-even point, represents that level of revenue at which neither excess revenue is made nor a loss is incurred by the university (See Figure 2). This break-even point in dollars can be checked as follows:

TABLE 4 - SCENARIO 1

GRAMBLING STATE UNIVERSITY
BREAK-EVEN POINT IN DOLLARS
1982-83

Revenue	$ 16,499,986
Less Variable Expenses (.4199201 X $16,499,986)	(6,928,677)
Contribution Margin available for fixed expenses plus excess revenue	$ 9,571,309
Less: Fixed Expenses	(9,571,309)
Excess Revenue or Loss	-0-

The computation of the break-even point can also be summarized in the following formula:

$$\text{Break-Even Point In Dollars} = \frac{\text{Total Fixed Expenses}}{1 - \frac{\text{Total Variable Expenses}}{\text{Total Operating Revenue}}}$$

Substituting the figures previously used:

$$\text{Break-Even Point In Dollars} = \frac{\$\ 9,571,309}{1 - \frac{6,928,677}{16,499,986}}$$

$$= \frac{\$\ 9,571,309}{1 - .4199201}$$

$$= \frac{\$\ 9,571,309}{.5800799}$$

$$= \$\ 16,499,986$$

Figure 2

Scenario 1

STATUS QUO : 1982-83

COST-VOLUME-REVENUE CHART

An alternative formula is:

$$\text{Break-Even Point In Dollars} = \frac{\text{Total Fixed Expenses}}{\text{P/V Ratio}}$$

The profit-volume ratio in this alternative formula equals the denominator in the previous formula, i.e.:

$$1 - \frac{\text{Total Variable Expenses}}{\text{Total Operating Revenue}}$$

The conventional income statement can now be replaced by a marginal income statement, which emphasizes the margin available for fixed expenses and excess revenue:

TABLE 5 - SCENARIO 1

GRAMBLING STATE UNIVERSITY
MARGINAL INCOME STATEMENT
FOR YEAR ENDED JUNE 30, 1983

Revenue	$ 16,827,688
Less: Variable Expenses (.4199201 X $16,499,986)	(6,928,677)
Contribution Margin available for Fixed Expenses and Excess Revenue	$ 9,899,011
Less: Fixed Expenses	9,571,309
Revenue in Excess of Expenditures	$ 327,702

Break-Even Revenue = Fixed Cost + Variable Cost

$16,499,986 = $9,571,309 + $ 6,928,677

The break-even point can also be computed in FTE students (FTES) or Head-count (HC). An essential step in computing the Break-Even Point (BEP) in FTES is the determination of the contribution margin (CM) per FTE:

Revenue	$ 16,499,986	= $ 4260
Divided by FTES	3873	
Less: Variable Cost/FTE	$ 6,928,677	= ($1789)
	3873	
Contribution Margin (CM)/FTE		$2471

By dividing total fixed expenses by the contribution margin (marginal income) per FTE, the break-even point is obtained:

$$\text{BEP In FTE} = \frac{\text{Total Fixed Expenses}}{\text{Contribution Margin/FTE}} = \frac{\$\ 9,571,309}{\$\ 2471} = \underline{3873}$$

If the fixed expenditures emanating from the 1984-85 Budget Request for Consent Decree Programs are added to the current level ($9,571,309) of fixed expenditures, the BEP would increase to 4775:

$$\frac{\text{Current Level of Fixed Costs}}{\$9,571,309} + \frac{\text{Fixed Costs of Consent Decree Programs}}{\$\ 2,228,699} = \frac{}{\$\ 2471}$$

$$\frac{\$\ 11,800,008}{\$2471} = \underline{4775}$$

GSU's BEP would increase to a slightly higher level if we considered the incremental fixed costs arising from the construction of the buildings for the Nursing and Business programs:

$$\frac{\text{Current Level of Fixed Costs}}{\$\ 9,571,309} + \frac{\text{Fixed Costs of Consent Decree Programs} + \text{*Operation \& Maintenance Costs}}{\$\ 2,228,669 + \$\ 38,009}$$

$$\frac{}{\$\ 2471}$$

$$= \frac{\$\ 11,838,017}{\$\ 2471} = \underline{4791}$$

Headcount = FTE X 1.025 = 4911

*The computation of the incremental operation and maintenance costs was included as part of the original report.

DIFFERENTIAL ANALYSIS: INCREMENTAL REVENUE AND INCREMENTAL STUDENTS

Differential analysis is a variation of cost-volume-revenue analysis. Differential analysis, however, focuses on those revenues and costs that will be changed should the course of action being considered be adopted. In terms of economic consequences, the revenues and costs that are relevant are only those that will be different as a result of the decision (Metz & Usry, 1976, p. 791-792).

Differential analysis is most useful for comparing the economic benefits of one alternative with those of another. "By comparing the difference in cost, educational planners and administrators can assess alternatives in terms of the significance of the net contribution to, or drain upon, institutional resources. Colleges and universities may use this type of analysis to examine a wide variety of courses of action such as changes in program, changes in the method of providing educational services, and variations in the level of service" (Robinson et al., 1977, p. 15).

After considering the impact of the Consent Decree Programs for 1984-85, the BEP in (Full-Time Equivalent Students) FTES and headcount increases to 4791 and 4911 respectively. It was also important to consider the incremental revenue which was required to support the additional students, programs and facilities. The following computations show that the new BEP (4791 FTE and 4911 HC) requires $3,907,577 in incremental revenue:

$$\text{BEP In Dollars} = \frac{9,571,309 + 2,228,699 + 38,009}{.5800799}$$

$$= \frac{11,838,017}{.5800799} = \$20,407,563$$

BEP In Dollars	$20,407,563
Less: Actual 1982-83 Reveue	(16,499,986)
Incremental Reveune Required	$ 3,907,577

BEP In FTES	4791
Less: Actual 1982-83 FTES	3873
Incremental FTES Required	918
BEP In Headcount	4911
Less: Actual 1982-83 Headcount	3970
Incremental Headcount Required	941

This simply means that the BEP in dollars must now increase from $16,499,986 to $20,407,563. On the other hand, the incremental FTES and headcount are computed as 918 and 941 respectively.

We can establish the accuracy or inaccuracy of the calculations of the incremental students (FTE or HC) by examining the alternative computations presented in Table 6. Using the minimum required student credit hours (SCHs) per full-time equivalent faculty member as a basic standard, the table indicates that the Consent Decree Programs must generate 846 additional FTE students. When the headcount conversion factor is multiplied by the FTE students, we are then able to derive a headcount enrollment of 867.

The alternative calculations of the incremental students required for the Consent Decree Programs are comparable to the numbers derived from the BEP analysis:

	FTES	Headcount
Incremental Students:		
BEP Analysis	918	941
Incremental Students:		
SCH/FTEF Standard	846	867
Difference	72	74

Table 7 shows the actual expenditures of Nicholls State and Northwestern for 1982-83. Notice that the actual expenditures of these two schools are in

TABLE 6

CONSENT DECREE PROGRAMS
SCENARIO 1 AND 2

Consent Decree Programs	No. of Faculty	Minimum Required SCH/FTE	Minimum Total SCH's Required (Col. (2) X Col. (3)	Minimum Required FTE Students Col 4 ÷ 12 or 15 Ⓐ
1. MSW	5	180	900	75
2. MALS	2	"	[illegible]	30
3. Nursing	12	420	5,040	336
4. MBA	18	180	3,240	270
5. MS - Criminal Justice	2	"	360	30
6. MS - Developmental Ed.	7	"	1,260	105
TOTAL	46	XXX	11,160	846 Ⓑ

Ⓐ Fulltime Equivalent enrollment was calculated by using the following values:

- Undergraduate students -- 15 semester credit hours equal one (1) FTE
- Graduate and first professional students -- 12 semester credit hours equal one (1) FTE.

Ⓑ Convert FTE to Headcount (See Budget Form A)

	1981-82	1982-83
1. Headcount	3928	3970
FTE	3707	3873
Ratio: HC/FTE	1.0596	1.025
Avg. Ratio	1.0423	

2. Multiply the FTE students by the conversion factors:

1.0423 X 846 = 882

1.025 X 846 = 867

25

26

TABLE 7 - SCENARIO 1

Nicholls State and Northwestern
E & G Expenditures
1982-83

Expenditure Category	Nicholls State	Northwestern
Instruction	$ 9,985,788	$ 9,640,868
Research	37,808	45,287
Public Service	-0-	-0-
Academic Support	2,574,720	1,788,937
Student Services	1,013,445	866,777
Institutional Support	2,551,308	3,052,416
Operation & Maintenance	2,617,947	4,350,067
Scholarships & Fellowships	195,000	268,050
Intercollegiate Athletics	1,365,730	1,062,858
Total Expenditures	$ 20,341,746	$ 21,075,260
FTE	7,772.5	5663
Headcount	7,226	6481

the same range as GSU's projected BEP of $20,407,563. The significance of comparing GSU to these two schools lies in the fact that the incremental fixed costs of the Consent Decree Programs will require GSU's budget for 1984-85 to reach the 1982-83 level of expenditures for Nicholls State and Northwestern. Obviously, a new permanent source of funding must be identified to support GSU's expanded programs, activities and facilities. The recurring costs which are created by GSU's expanded capacity will require funding much beyond the termination date of the Consent Decree. With this basic fact in mind, program planners were admonished to be realistic and cautious in implementing a wide array of new and expanded programs.

SENSITIVITY ANALYSES

To indicate the impact of implementing an expanded array of Consent Decree Programs on GSU's BEP, sensitivity analyses were performed. Sensitivity analyses gave GSU's executive management the ability to ascertain the effects of various assumed levels of incremental fixed costs on the university's BEP. Detailed computations supporting the analyses were prepared and tabulated. As evidenced in Table 8, GSU's status quo BEP increases from FTE and HC enrollments of 3873 and 3970 to 5195 and 5325 respectively, when an additional $1,000,000 of fixed costs are required beyond the 1984-85 budget requests for Consent Decree Programs. Alternatively, the BEP in dollars increases from $16,499,586 to $22,131,463, an increase of $5,631,477. An Additional $2,000,000 of fixed costs raises the FTE and HC enrollments to 5600 and 5750. The BEP in dollars for these levels of enrollments increases to $23,855,365, an increase of $7,355,379. Lastly, if GSU were to implement Consent Decree Programs requiring an additional $3,000,000 of fixed costs, the BEP would rise to 6005 FTE and 6155 HC. The significantly higher BEP would now demand an Operating Budget of $25,579,264, an astronomical increase of $9,079,278. Acquiring a budget increase of nine million dollars over the next few

TABLE 8 - SCENARIO 1

SUMMARY OF SENSITIVITY ANALYSES

Item	Incremental Fixed Cost	Status Quo/New BEP		Status Quo/New BEP
		FTE	Headcount	Dollars
Status Quo	-0-	3873	3970	$ 16,499,586
Consent Decree Programs (1984-85)	$ 2,228,699	4775	4894	$ 20,342,039
Operation & Maintenance:				
Nursing & Business Buildings	$ 38,009	4791	4911	$ 20,407,563
Additional Consent	$ 1,000,000	5195	5325	$ 22,131,463
Decree Programs	$ 2,000,000	5600	5740	$ 23,855,365
and Costs	$ 3,000,000	6005	6155	$ 25,579,264

years becomes a sobering thought, when one considers the current and projected future economic conditions in the state. Table 9 contains a summary of the sensitivity analyses for Scenario 2.

SCENARIO 2

COST BEHAVIOR ANALYSIS AND LEAST SQUARES

Grambling State University's Operating Budget depends upon and requires careful study and analysis of the relationship of expenses to volume of activity (FTE, HC or SCH). This relationship of expenses to activity is commonly known as cost behavior. More specifically, cost behavior can be defined as the way in which costs change or respond to changes in some underlying level of activity, such as sales volume, production volume, or other variables (Garrison, 1982, p. 40).

A study of cost behavior will invariably result in classifying expenses as (1) fixed, (2) variable, and (3) semivariable. The classification of expenses or expenditures as variable, fixed, and semivariable is important because (a) the dollar amount of variable expenses varies more or less in direct proportion to volume or activity, but the variable expense unit cost tends to remain constant at any volume level; (b) the dollar amount of fixed expenses remains constant at any volume level but the fixed expense unit cost diminishes with increased volume; (c) the dollar amount of semivariable expenses increases with increased volume or activity but not so steadily or uniformly as variable expenses; the semivariable expense unit cost does not diminish with increased productivity in a manner similar to fixed expenses (Matz et al., 1976, p. 221-222).

The determination of fixed and variable elements of a semivariable expense and the creation of total fixed and total variable costs play a major role in cost control, revenue and enrollment planning, budget development, and decision-making.

TABLE 9 - SCENARIO 2

SUMMARY OF SENSITIVITY ANALYSES

Item	Incremental Fixed Cost	Status Quo/New BEP FTE	Status Quo/New BEP Headcount	Status Quo/New BEP Dollars
Status Quo	$ -0-	3873	3970	$ 16,499,586
Consent Decree Programs (1984-85)	$ 2,509,908	4599	4714	$ 19,591,873
Operation and Maintenance: Nursing & Business Buildings	$ 42,056	4611	4726	$ 19,643,681
Additional Consent Decree Programs and Costs	$ 1,000,000	4901	5024	$ 20,875,554
	$ 2,000,000	5190	5320	$ 22,107,427
	$ 3,000,000	5479	5616	$ 23,339,300

This particular study employs the fixed-variable cost concept quite extensively in the following analytical processes:

(1) Computing the break-even point.
(2) Making cost-volume-revenue analyses.
(3) Providing marginal cost information.
(4) Planning for growth in enrollment, programs and facilities.
(5) Determining the effect of alternative courses management might wish to follow (Differential cost decisions).
(6) Projecting of expenses for various levels of activity.

The use of the analytical processes is evidenced throughout the narrative, tables and figures.

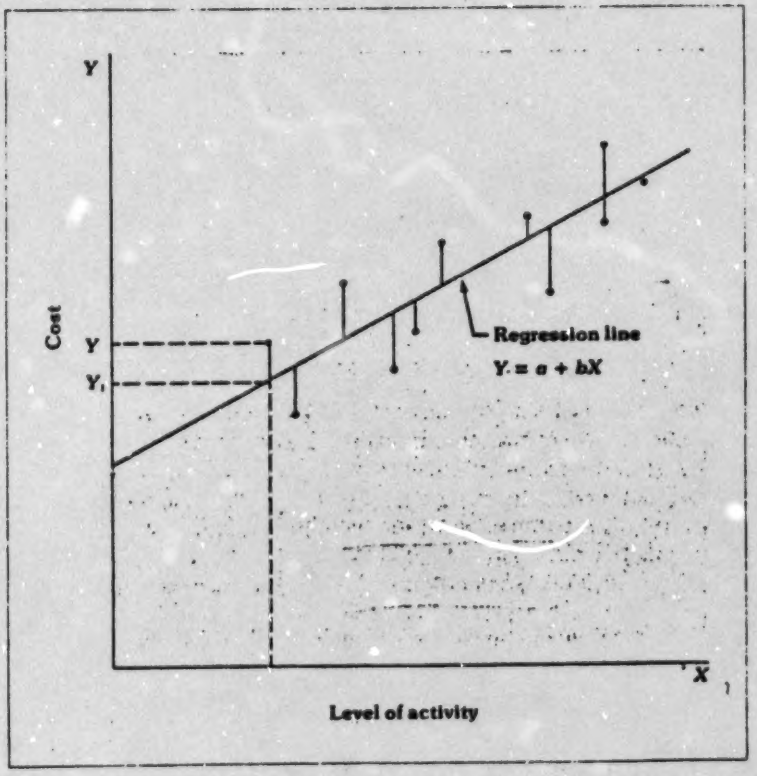
A METHOD OF COST BEHAVIOR ANALYSIS: LEAST SQUARES

Without a knowledge of the underlying cost behavior patterns involved, it would be difficult if not impossible for GSU to properly analyze its cost structure. The reason is that all costs do not behave in the same way. One cost might move in one direction as a result of a particular action, and another cost might move in an opposite direction. Unless the behavior pattern of each cost is clearly understood, the impact of the university's activities on its costs will not be known until after the activity has occurred.

The Least Squares Method (Linear Regression) is generally considered to be an accurate method of cost analysis since it fits a regression line to an array of data by statistical analysis. The term "least squares" means that the sum of the squares of the deviations from the plotted points to the regression line is smaller than would be obtained from any other line fitted to the data. This idea can be illustrated as shown in Figure 3 (Garrison, 1982, p. 165). The deviations from the plotted points to the regression line are measured vertically on the graph. They are not measured perpendicular to the regression line. "Least Squares" will have been attained when $\Sigma (Y - Y_1)^2$ is at the lowest possible figure. At the point of "least squares" the best possible fit of a regression line

FIGURE 3 - SCENARIO 2

THE CONCEPT OF LEAST SQUARES



to the plotted points will have been achieved, in terms of slope and placement of the line (Lapin, 1981, p. 323).

Before explicating how the least squares method was applied in analyzing GSU's Education and General Expenditures, four more important points should be made:

(1) A regression line is a line of averages depicting the total variable and fixed cost elements of a mixed cost for all points of activity within the relevant range.

(2) A regression line can be expressed in formula form as $Y = a + bx$. The "a" term represents the fixed cost element, and the "b" term represents the variable cost element per unit of activity.

(3) The fixed cost element is represented where the regression line intersects the vertical axis on the graph.

(4) The rate of variability is represented by the slope of the line (Kroeber & LaForge, 1980, p. 142-143).

The least squares method was initially applied to GSU's Unrestricted Educational and General Expenditures for the last five years (1978-1983).

It was discovered that GSU's E & G expenditure patterns had been somewhat erratic and inconsistent over the last five years (1978-1983). Because of this fact, the analyst was forced to extend the linear regression analysis beyond five years. In extending the statistical analysis, the analyst had to use budget figures as surrogates because internal financial statements were unavailable prior to 1978. The analyst attempted to create a "smoothing effect" by retroactively applying the five-year average percentages to each category of E & G. Also, in calculating the cost formula for E & G expenditures, the analyst had to adjust some of the slopes of the regression lines.

An Example of A Cost Formula

Using the data presented in Table 10, it was possible to derive a cost formula for instruction which could be used for planning purposes:

Cost formula for instruction over the relevant range of 3873 FTE to 6005 FTE } = $5,261,970 fixed cost + $93.68 per FTE

TABLE 10 - SCENARIO 2

COST FORMULA FOR INSTRUCTION

Variable X: F.T.E.		Variable Y:	Instruction
Mean of X =	3,619.40	Mean of Y =	5,601,040.00
S.D. of X =	9.00	S.D. of Y =	649.17

Number of Pairs (N)	=	5
Correlation Coefficient (R)	=	0.7450
Degrees of Freedom (DF)	=	3
Slope (M) of Regression Line	=	93.68 *

Name	X_{Value}	Slope	Fixed Cost	Y_{Value}
Instruction	3,595.00	93.68	5,261,970.00	5,598,760.00
"	3,317.00	"	"	5,572,710.00
"	3,605.00	"	"	5,599,690.00
"	3,707.00	"	"	5,609,250.00
"	3,873.00	"	"	5,624,800.00

*Represents the adjusted slope

In terms of the linear equation Y = a + bx, the cost formula can be expressed as:

$$Y = \$5,261,970 + 93.68x$$

For planning purposes, if it is expected that 3873 FTE students will enroll during the coming semester, the expected total instructional costs will be:

Variable Costs:	
3873 FTE X $93.68	$ 362,823
Fixed Costs	5,261,970
Total Expected Instructional Costs For Coming Semester	$5,624,793

The cost formula gives a manager the ability to make projections of costs and to prepare budgets which can be geared to a range of activity rather than a single level.

GSU's Fixed Cost Proportions

After all of the linear regressions were completed and cost formulas were developed for all categories of E & G, a matrix showing GSU's Fixed Cost Proportions by expenditure category was prepared; this matrix is shown in Table 11. Notice that in the upper left-hand corner of each cell there appears the letters FTE or HC, and in the upper right-hand corner, there appears a number in parenthesis ( ). The letters FTE or HC simply signify that full-time equivalent enrollment or headcount enrollment was used in the regression analysis. The number in the right hand corner indicates the number of years over which the linear regressions were computed. The larger numbers in the center of cells indicate the proportion of fixed costs which were computed in each of the respective linear regressions. Lastly, the cells to the extreme right of the matrix contain the average fixed cost percentages for each expenditure category.

The fixed cost percentages from Table 11 were applied to the 1982-83 actual expenditures and the 1984-85 budget requests for Consent Decree Programs. This

TABLE 11 - SCENARIO 2

GSU'S FIXED COST PROPORTIONS

Expenditure Category								Average Proportion
Instruction	FTE (5) 93.9	HC (5) 95.7	HC (7) 49.1	HC (8) 90.5				82.3
Research	HC (6) 82.1							82.1
Public Service	HC (7) 80.6	HC (10) 53.7	HC (15) 69.5					68.0
Academic Support	FTE (5) 92.1	HC (5) 66.2	FTE (6) 69.0	FTE (6) 85.9	HC (6) 68.9	HC (10) 73.7		76.0
Student Services	FTE (6) 81.3	HC (7) 58.3	HC (8) 90.4					76.7
Institutional Support	FTE (5) 95.7	HC (5) 85.1						90.4
Operation & Maintenance of Plant	FTE (5) 94.4	HC (5) 95.9	HC (6) 63.4	HC (10) 74.8	HC (15) 97.6			85.2
Scholarships & Fellowships	FTE (5) 88.9	HC (5) 80.5	FTE (6) 52.9	FTE (6) 80.4	HC (7) 90.9	HC (10) 43.8	HC (15) 69.4	72.4
Athletics	FTE (8) 54.1	HC (10) 66.0						60.1

process led to the development of the total fixed costs which were employed in the cost behavior analyses and the ultimate computation of GSU's BEP.

As a way of establishing the validity of the projected fixed cost proportions, the analyst examined GSU's tenured faculty salaries with respect to the university's instructional expenditures. When expressed as a percent of total instructional expenditures, the compensation paid to GSU's tenured faculty has averaged nearly 70% (68.68) over the last five years. Obviously, this analysis revealed that there was a high proportion of fixed cost in the university's instructional expenditures. The yearly percentages for tenured faculty salaries closely rivaled the fixed cost proportions for instructional expenditures. It is a well known and established axiom that high tenure density is directly linked with a high level of fixed cost. GSU's tenure rate has averaged 70% over the last five years. In fact, the tenure rate reached a high of 79.7% in 1981-82.

A high level of fixed cost can, in fact, greatly limit financial flexibility and viability. Short of a financial exigency, when GSU's enrollment declines or remains stable, little can be done to reduce the university's commitment to pay tenured faculty salaries. This financial inflexibility can occur at a time when the university's revenues have either declined or stabilized.

RESULTS/CONCLUSIONS

Scenario II disaffirms the assumption that the fixed cost proportions of GSU's Educational and General Expenditures are the same as other institutions having similar operating conditions. By applying linear regression to the university's accounting data, it was established that GSU's fixed cost proportions were much higher than those developed by the Ohio Board of Regents. This basic fact is significant because with the implementation of Consent Decree

Programs, fixed costs could become an increasing proportion of current operating income. The behavior of institutional cost can be a major cause of financial instability and/or inflexibility.

The cost-volume-revenue charts and the sensitivity analyses have shown that the university's fixed costs increased throughout the entire range of activity portrayed on the graphs. Simply stated, both the fixed cost line and the total cost line shifted upward. The shifts in the fixed cost line and the total cost line caused the break-even point to occur at significantly higher FTE or HC enrollments.

Financial instability could occur if GSU could not fund the higher level of fixed costs emanating from Consent Decree Programs. To fund the 1984-85 Budget Requests, the university's Operating Budget would have to increase by a minimum of 24% per Scenario 1 and 19% per Scenario 2.

Furthermore, if we assume that an additional three million dollars of fixed costs will be incurred in years subsequent to 1984-85, the break-even point in dollars increases to $25,579,327 in Scenario 1 and $23,339,320 in Scenario 2; the incremental revenue required is $9,079,471 and $6,839,734 respectively. Acquiring a budget increase of seven or nine million dollars over the next few years becomes a sobering thought, when one considers the current and projected future economic conditions in the state. Financial instability could have occurred if the university were forced to defray the incremental cost of Consent Decree Programs from its existing level of funding.

However, such a calamitous result did not occur because the university received an approved Operating Budget of $21,845,61[illegible] for 1984-85. According to Table 9, GSU had to achieve a BEP of $19,591,873 to cover the incremental fixed costs of Consent Decree Programs. It is obvious that the university received a

level of funding which exceeded the projected BEP.

Referring to Table 9 again, notice that the projected break-even enrollments were 4502 FTE and 4714 HC. These projected enrollments were very close to GSU's actual FTE and HC figures for the Fall of 1984:

	Term/Year	FTE	HC
Actual:	Fall 1984	4502	4767
Projected:	Fall 1984	4599	4717
Difference:		(97)	50

GSU's executive management had informed the Board of Regents that no new programs (Consent Decree) would be started with insufficient funds. By being very adamant in this position, executive management was able to secure $2,823,403 (93%) of the $3,049,705 which had been requested for 1984-85.

IMPLICATIONS

The ability to project cost and revenue depends on an understanding; first, of the way in which variable, fixed, and mixed cost will behave and; second, of how environmental factors and institutional decisions can effect that behavior. Typically, cost behavior is examined for a specified time period and within a relevant range of level of service. By classifying and analyzing cost behavior, administrators will gain important insights concerning the need for economic resources. They will understand the relationship of cost to various levels of service activity, and thus will learn what would happen to cost if service levels were changed, as they will learn how different variables influence costs. These kinds of insights into cost behavior are fundamental to intelligent management of resources and are common to most types of service and production activities. Yet this method of analysis has been all but ignored in the literature intended for the guidance of college and university administrators (Robinson et al.,

1977, p. 7).

Since the analysis of cost-volume-revenue relationships is one of management's most significant responsibilities, it is strongly recommended that administrators employ the concepts discussed in this paper when examing the possible consequences of decisions about the use of resources. Basically, the analysis will involve finding the most favorable combination of variable and fixed costs in relation to revenue and FTE or headcount enrollment. Cost-volume-revenue analysis provides the manager with a powerful tool for identifying those courses of action which will not insure financial stability and financial flexibility.

A second major recommendation requires a careful integration of academic, fiscal, and facilities planning before new programs are implemented. An integration is necessary so that the university can ascertain the impact these programs will have in strategic decision areas. Integrated planning leads to understandings about the decision of labor and objectives of the institution and each of its components. Each planning/budgeting unit is aware of what other units seek to accomplish. Hence, this awareness can create an environment of collegiality when critical decisions must be made.

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